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ABSTRACT

This study conducted in the Netherlands examines the role of student-generated learning issues in a problem-based curriculum. The first questions was in which way students make use of the learning issues generated (as strict guidelines or as global guidelines) and does this differ between years of training? The second questions was what the relation is between the way students make use of their learning issues and the time spent on individual study and achievement? Questionnaires were completed by 479 students in the first 4 years of a 6-year medical training program. Results show that students in the first year study strictly according to the content of the learning issues. In later years, students who tend to study beyond the generated learning issues spend more time on individual study and also achieve better. (Contains 4 tables and 15 references.) (Author/SLD)

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The impact of student-generated learning issues on individual study time and academic achievement

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This study examines the role of student-generated learning issues in a problem-based curriculum. The first question was in which way students make use of the learning issues generated (as strict guidelines or as global guidelines) and does this differ between the years of training? The second question was what the relation is between the way students make use of the learning issues and the time spent on individual study and achievement ? Results showed that students in the first year, study strictly according to the content of the learning issues. In later years students study more according to their own learning needs. Secondly, students who tend to study beyond the generated learning issues, spend more time on individual study and also achieve better.

In problem-based learning (PBL) students are encouraged to take substantial responsibility for their own learning. Independent and active learning is stimulated by discussing problems in small groups.[1] A problem consists of a description of a set of phenomena needing some kind of explanation. The discussion provides unanswered questions which subsequently serve as a guide for independent and self-directed learning.[2] These questions are called student-generated learning issues and are described by Blumberg and colleagues[3] as factual or conceptual topics that each group decides must be better understood in order to analyse adequately the problem under discussion. Student-generated learning issues are an essential starting point for students' individual study and it is assumed that they play an important role in students' development of self-directed learning.[4] According

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to Knowles[5], self-directed learning can be seen as a process in which individuals take the initiative with or without the help of others in diagnosing their learning needs, formulating learning goals, identifying
human and material resources, choosing and implementing appropriate learning strategies and evaluating learning outcomes.
Some evidence for self-directing learning behaviour in PBL was found in a study by Blumberg and Michael.[6] They found that PBL-students used more resource materials than students in a conventional curriculum. Similarly, in a study at self-directed learning skills of first year students in a PBL curriculum, Dwyer[7] found that students at the end of the first year were feeling very much encouraged to identify learning needs, and were more motivated to identify resources as compared to the beginning of the year. Ryan[8] studied students' perceptions about their self-directed learning when they were enrolled in a course which implemented problem-based learning. He concludes that students had changed their perception of the importance of self-directed learning, and at the end of the year had a more positive perception of their ability as self-directed learners. So, it seems that when students are responsible for their own learning, they acquire autonomous learning skills, and learn to be better self-directed learners as they progress their studies.
In PBL student-generated learning issues play an important role in this process. In a study by Dolmans and Schmidt[9], indirect evidence was found for this relationship in a four year curriculum. They focused on the extent to which various elements of a problem-based curriculum influence students' decisions as to what to study. It was found that not only student-generated learning issues, but also other elements may have an impact on students' study decisions. These elements were literature cited in the reference list, content covered in lectures and content of tests. The influence of these elements tended to decrease over the four curriculum years. The influence of generated learning issues, on the contrary, tended to increase over the four years. It was concluded that students in a problem-based curriculum become more accomplished self-directed learners.
The extent to which students use the learning issues to define the content of individual study is a process that can differ between students, because PBL-students are highly responsible for their own learning. First- and second-year students for example, who are not yet experienced self-directed learners, are consequently expected to rely more strongly on the learning issues formulated. With more seniority, students are expected to become better self-directed learners. This would imply that they will be better able to follow their own needs and interests during their individual study. Thus, it is expected that students in a problem-based

curriculum in the first curriculum years will use learning issues as strict guidelines to study the literature step-by-step, whereas in later years they will use learning issues as global guidelines that fit their individual needs and interests better. The aim of this study was, first of all, to test this hypothesis and to find out whether there are differences between the years of training. If students, in the higher curriculum years, show increased use of learning issues as global guidelines, and rely more on their own needs and interests, this might indicate that students become better self-directed learners.
A follow-up question addressed in this study was whether students who used learning issues more as global guidelines that fit their personal needs and interest, would spend more time on individual study. In a problem-based curriculum, scheduled activities (tutorial groups, lectures, skills training, etc.) are kept at a minimum per week to provide ample time for individual study.[10] It was expected that students who studied beyond the learning issues generated, would spend more time on individual study. In addition, it was also expected that students with this learning approach would achieve better on performance tests. The examination system in a problem-based curriculum, such as the one under investigation, is aimed at rewarding extra learning activities during individual study and is aimed at avoiding test-driven study behavior.[11]
In summary, two questions are dealt with in this study. First, in which way do students make use of the generated learning issues (i.e. as strict guidelines or as global guidelines) and is there a difference according to year of training? Second, how does the use of generated learning issues relate to time spent on individual study and achievement on performance tests?

Method

Materials

The study was conducted at the Medical School of Maastricht University in the Netherlands, during the academic year 1995-1996. Prior to the construction of a questionnaire, 12 students were interviewed to gain more insight into whether and to what extent learning issues play a role during individual study. Based on their responses a questionnaire was developed. In this questionnaire seven items assessed the extent to which students study strictly according to the student-generated learning issues (learning issue restrictive approach) and six items measured the extent to which students study beyond the student-generated learning issues (learning issue broadening approach). The first dimension (learning issue restrictive approach) reflects the use of learning issues as items that need to be answered step-by-step. The second dimension (learning issue broadening approach) reflects the extent to which students follow their own interest and their individual learning needs. The items of both dimensions are shown in figure 1. Students were asked to give their opinion on each item using a 5-point Likert scale ranging from (1) totally disagree to (5) totally agree.

Figure 1. Seven items of the questionnaire measuring the learning issue restrictive approach and six items measuring the learning issue broadening approach.

Items of dimension *"learning issue restrictive"*	Items of dimension *"learning issue broadening"*
During my individual study I use learning issues as a ...	- When I am absent in the tutorial group, I formulate my own learning issues
-guideline to determine what literature I 'm going to study	- I choose literature on the basis of my interest regardless of whether it is important for the block-content
-check to see if the literature I have studied covers the content	- I often formulate my own learning issues
-guideline to determine to what depth I must study certain topic	- I study more broadly than what is only necessary to answer the learning issues
-guideline to mark out the subject matter	- When my individual study is restricted to the learning issues, I am afraid I will have gaps in my knowledge
-guideline to distinguish main topics and side topics	- During my individual study I always try to integrate different topics
-guideline to study literature step-by-step	
During individual study I am guided by	
-the learning issues generated in the tutorial group	

To assess construct validity of the two dimensions, a confirmatory factor analyses was performed.[12] The results showed a chi-square value of 217.75 (df = 64, N=479), p <.06, an adjusted goodness-of-fit index (AGFI) of .89 and a root mean square residual (RMSR) of .06. The constraints as defined by Saris and Stronkhorst [13] are met, such that the data are assumed to fit the two dimensions reasonably.
The questionnaire further contained one additional question in which students had to estimate the mean time they spent on individual study per week. A study by van Til and colleagues [14] showed that this method provides a reasonably reliable indicator of time spent on individual study.
Academic achievement was measured by using the scores on two different forms of tests.

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The first type was the block test. In general the block test, administered after each block, reflects the content of the foregoing block of six weeks. The major goal is to assess students' knowledge about the block contents and to provide students with feedback on their achievement in relation to the course objectives. Each test is composed of 160 to 190 questions in the true/false format with an 'I don't know' option (the question-mark option). A correct answer scores plus one, with an incorrect answer scoring minus one. The question mark scores zero. The overall score is the correct minus incorrect score and is expressed on a percentage scale.
The other test is the progress test. All students of every year of training are required to take the Progress test which is a comprehensive test at graduate level, sampled from the total body of medical knowledge, four times a year.[11] Students cannot prepare themselves for the progress test and it therefore rewards the individual non-test directed study activities of students. Each test consists of approximately 250 true/false items, with a question mark option. Total score is expressed similarly as with the block test.

Procedure

The questionnaire was administered to all students of the first four years of training (the Maastricht programme is a 6-year training programme), at the end of the academic year 1995-1996.
For each student a mean score was computed across the items measuring both dimensions (learning issue restrictive approach and learning issue broadening approach). To facilitate the interpretation of the data, the mean scores were categorized into three groups: the lowest group (mean score < 3), a middle group (score between 3 and 4) and the highest group (mean score > 4). For each group the mean time spent on individual study was calculated. Block-test scores were transformed into z-scores per year and averaged across all seven tests of that year. The same procedure was followed with scores from all four progress tests in each year of training.
Differences between students' scores in each dimension on the hours spent on individual study and the test-score were analysed using ANCOVA with years of training as a co-variate. Specific differences across the years of training were analysed with post-hoc analyses, using the Scheffé F-test.

Results

In total 479 students filled in the questionnaire (response 69%). In the first year the response rate was 73% (n=155), in the second year 72% (n= 149), in the third year 72% (n=101) and 55% (n=73) in the fourth year.
Results in Table 1 show that the mean score on the first dimension (learning issue restrictive approach) was highest among first-year students and the lowest in the third and fourth year. These scores differ significantly $F(3, 468) = 7.19, p < .001$, i.e., Scheffé F-test showed that the mean score of the first-year students differs significantly from those of the third and the fourth-year students.

Table 1. Mean scores on the dimensions (mean), standard deviation (sd), number of students (N) for the total group and per year.

	Learning issue restrictive approach			Learning issue broadening approach		
	mean	sd	N	mean	sd	N
Year 1	3.7	.6	151	3.1	.6	151
Year 2	3.6	.6	145	3.4	.6	144
Year 3	3.4	.7	101	3.4	.8	101
Year 4	3.4	.7	74	3.5	.7	74
Total group	3.6	.7	471	3.3	.7	470

Table 1 also shows that for the second dimension (learning issue broadening approach) students score lowest in the first year and highest in the fourth year. The scores between years differ significantly on this dimension [$F(3, 467) = 5.81$, $p < .001$], that is, the first-year students differ significantly from the second, third and fourth-year students.

Table 2. Mean hours spent on individual study (mean), standard deviation (sd), number of students in each group (N) for both dimensions (learning issue restrictive approach and learning issue broadening approach), split up for students scoring low, middle and high on each dimension

	Learning issue restrictive									Learning issue broadening								
	Low			Middle			High			Low			Middle			High		
	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd	N
Year 1	14	6	13	15	8	59	16	6	53	14	6	39	16	8	68	19	9	18
Year 2	22	6	15	18	7	58	19	6	38	16	6	26	18	7	64	24	8	22
Year 3	16	8	21	16	8	47	20	8	19	15	5	25	18	9	41	18	8	21
Year 4	29	8	16	18	6	32	17	7	16	14	9	17	19	6	34	20	8	21
Total	18	8	65	17	7	196	18	7	126	14	6	107	17	7	207	20	9	82

Table 2 gives the mean time spent on individual study for three groups: students scoring in the low, middle and high ranges on each dimension. The three groups in the dimension "learning issue restrictive" do not differ significantly on the hours spent on individual study $F(2, 385) = .90, p < .405$. For the dimension "learning issue broadening" groups differ significantly in hours spent on individual study $F(2, 384) = 10.80, p < .001$. These differences cannot be explained by years of training $F(1, 378) = 1.379, p < .241$. Table 2 gives the mean time spent on individual study for three groups. The three groups in the dimension "learning issue restrictive" do not differ significantly on the hours spent on individual study $F(2, 385) = .90, p < .405$. For the dimension "learning issue broadening" groups differ significantly in hours spent on individual study $F(2, 384) = 10.80$, $p < .001$. These differences cannot be explained by years of training $F(1, 378) = 1.379, p < .241$. For all years, students with the highest score on this dimension reported the most time spent on individual study and students with the lowest score on this dimension reported the least time spent.

Tables 3 and 4 contain the mean block-test and progress-test scores for each group in each dimension. Table 3 indicates that groups in the first dimension (learning issue restrictive approach) differ in their block-test achievement. A trend is shown that the more students study strictly according to the learning issues, the lower their score on the block-test. However, these differences are not significant $F(2, 464) = 2.20, p < .112$. The groups categorized on the second dimension (learning issue broadening approach) differ significantly on the block test $F(2, 465) = 5.81, p < .001$.

Table 3. Mean z-scores on block-test (mean), standard deviation (sd), number of students in each group (N) for both dimensions (learning issue restrictive approach and learning issue broadening approach), split up for students scoring low, middle and high on each dimension

	Learning issue restrictive									Learning issue broadening								
	Low			Middle			High			Low			Middle			High		
	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd	N
Year 1	.09	.8	17	.14	1.0	74	-.18	1.0	59	-.27	1.0	45	.13	.9	84	.15	1.0	17
Year 2	.39	.4	19	.05	.9	71	-.23	1.0	42	-.30	.8	29	-.02	1.0	73	.33	1.0	29
Year 3	-.21	1.0	28	.08	.9	57	.53	1.2	22	-.06	1.0	33	.06	1.0	47	-.03	1.0	27
Year 4	.24	1.1	19	-.13	.9	39	-.00	.7	19	-.37	.9	20	.08	.9	39	.16	1.0	24
Total	.09	1.1	83	.05	.9	241	-.14	1.0	142	-.24	.9	127	.06	.9	243	.16	1.0	97

No significant effect for years of training $F(2, 465) = .10, p < .745$ was found. The scores on the block test are higher when students have higher scores on the dimension. In other words, the more students study by going beyond the learning issues, the higher their score on the block test.

Table 4. Mean z-scores on progress- test (mean), standard deviation (sd), number of students in each group (N) for both dimensions (i.e. learning issue restrictive approach and learning issue broadening approach), split up for students scoring low, middle and high on each dimension

	Learning issue restrictive									Learning issue broadening								
	Low			Middle			High			Low			Middle			High		
	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd	N
Year 1	.17	.8	17	.02	1.0	74	-.03	.9	59	-.12	.8	45	.06	1.0	84	.06	1.3	17
Year 2	.51	1.4	19	-.02	.8	71	-.18	.9	42	-.19	.8	29	-.10	1.0	75	.49	1.3	29
Year 3	.08	1.0	28	-.05	.8	57	.53	1.2	21	-.07	.8	31	-.03	.8	47	.16	1.1	27
Year 4	.31	1.1	19	-.13	1.0	39	-.05	.5	19	-.24	.6	19	.06	1.0	37	.08	1.2	24
Total	.26	1.1	83	-.03	.9	241	-.06	.9	141	-.14	1.8	124	-.00	.9	243	.23	1.2	97

In Table 4 the results for the progress test are shown, indicating that the three groups specified in the first dimension (learning issue restrictive approach) differ on the scores on the progress test. These differences are significant $F(2, 463) = 5.60, p < .001$. No significant effect for years of training $F(2, 463) = .51, p < .474$ was found. Students who reported low on this dimension have higher scores on the test, whereas students who reported high on this dimension have low scores on the progress test. Groups in the second dimension (learning issue broadening approach) also differ significantly on the progress test $F(2, 465) = 7.90, p < .001$. There was no significant effect for years of training $F(2, 465) = .29, p < 590$. Students who reported high on this dimension have also higher scores on the progress test compared to students who reported low.

Discussion and Conclusion

The first aim of this study was to answer the question to what extent students restrict themselves to the learning issues generated in the tutorial group and to what extent they go beyond the learning issues. The first conclusion of this study, is that especially first-year students, use learning issues in a different way from students in the senior years. First-year students confine themselves more strictly to the content of learning issues. This implies that they are answering them step-by-step, using them as a tool to demarcate the literature. In later years students study more according to their own learning needs and interests, and not only according to topics directly related to the learning issues generated.

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A possible explanation is that students in the first year are uncertain about what literature should be studied. Senior students probably feel better able to determine independently what to study. Thus, students seem to become better self-directed learners during the years of training. Vermunt [15] states that when students are able to regulate their own learning process and when the instruction programme is not heavily externally regulated, there is no friction in the learning process of students. Perhaps students in later years need less external regulation, and therefore are more likely to go beyond the learning issues generated being better able to regulate their own learning needs than first-year students. The data of the present study, however, were not gathered longitudinally, so differences between years of training can still be explained by differences in each group.

Another explanation of the fact that students in later years study more beyond the learning issues, might be that the quality of the student-generated learning issues decreases during years of training. In the interviews taken with three students of each year, students in the third and fourth year mentioned that the tutorial groups were sometimes less functional than in the first and second year. This could have a negative impact on the learning issues generated and students would then be forced to determine for themselves what is important to study. However, in the same interviews, students in each year reported that learning issues were an important starting point for individual study. Further research is needed to clarify this issue.

The second aim of this study was to explore the relation between the use of learning issues and the time spent on individual study and achievement. The results showed that students who go beyond the learning issues, spent more time on individual study and also achieve better. It seems that when students are developing themselves as self-directed learners, they will be rewarded within PBL. Students do achieve better when they study more than what is directly related to the learning issues and therefore it is important that students must be stimulated to study beyond the learning issues and must develop the skills bo be able to determine independently what is important for their study.

An alternative explanation might be that students who go beyond the learning issues are more test-driven instead of being better aware of a certain lack in their knowledge. They spend more time on studying topics for better understanding of the materials that are tested in stead of only satisfying their own learning needs. Pure test-driven learning could be rewarded by the block test but not by the progress test. Yet, the effects were similar for both tests. A remedial approach, checking blank spots and studying systematically, might, however, be considered as an important self-directed learning skill.

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